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Science and Art Gossip.

AN observation, unprecedented in the history of comets, was made at the Cape Town Observatory, on Sept. 17, at 4 h. 50 min. 58 sec. Cape mean time, corresponding to 3 h. 37 min. 3 sec. Greenwich time. "The comet was followed," writes Mr. Gill, "by two observers with separate instruments, right up to the sun's limb, where it suddenly disappeared," at the hour named. To be seen under these conditions the comet must at the time have been intensely brilliant—partly, no doubt, the effect of solar heat and light, but partly also, we conceive, on account of the resistance it experienced in its onward rush at the rate of certainly not less than 340 miles per *second!* The time when Mr. Gill's assistants saw the comet reach the sun's limb, preceded by 1 h. 35 min. the time of perihelion passage as given below.

THE Emperor of Brazil telegraphs to the Academy of Sciences that the comet was visible in full daylight on the 18th, 19th, and 20th September. The spectroscope showed the presence of sodium and carbon. On the 26th, from 4 h. 10 min. to 5 h. 40 min. in the morning, it was a splendid object.

DR. HIND finds now for the comet the following elements: Perihelion Passage, Sept. 17·2169 Greenwich M.T.=Sept. 17, 5 h. 12 m. p.m., instead of Sept. 17 about 2 h. 30 m. p.m.

	New estimate.	Comet, 1668.	Comet, 1843.
Longitude of Perihelion	276 14·5	277 2	278 39
„ „ Ascending node	346 7	357 17	361 12
Inclination	37 59	35 58	35 41
Logarithm of Perihelion Distance	7·90653	7·67210	7·74036

(We have added 360° to the Long. of Asc. node of comet 1843 to make the comparison easier.)

WE publish elsewhere an interesting letter (which appeared in last Saturday's *Times*) about the comet. But what a pity it is people will not learn enough of elementary matters in astronomy to write correctly. The letter, for want of such knowledge, is full of absurdities. The comet is "appearing in latitude 10° N," it "rises almost perpendicular to the sun," and "travels the length of its tail (45°) in less than an hour" (which would involve a real motion among the stars at the rate of 30° in less than an hour, or twice round the star sphere in less than a day!); it "measures some 3,000 miles to the naked eye from its corona," and at such and such a time "the great flame was in an apparent flutter," which is all just impossible nonsense.

THE Isle of Wight will be raised to white heat by the too rapid motion of its trains. A rate of fourteen miles in an hour and a quarter is advertised. Luckily for the island this terrific speed is not always attained.

THE Peterhead Police Commissioners have resolved that the electric light shall not be supplied to their town by any company. They are the owners of the gas-works. There appears to be on the part of the various corporations, &c., throughout the country, a determination to resist the introduction of the electric light into their respective districts by the companies owning the patents. However, many of these local bodies contemplate introducing the light on their own account. If this spirit is maintained, the concessions for which so many thousands have been paid will be scarcely worth the paper they are written on.

THE TELEPHONE AND BALLOONING.—Last week several ascents were made by members of the Academie d'Aérostation Météorologique, from the Place Saint Jacques, Paris. Amongst other things, conversation was carried on with people on the earth by means of a telephone line suspended from the balloon. The height at which the balloon is said to have been was 500 ft.

A MINE has been found in a mountain near Salzburg, Austria, which, it is considered, gives indications of having been occupied and abandoned at least two thousand years ago. It contains a large and confused mass of timbers, which were used for support, and a number of miners' implements. The timbers were notched and sharpened, but were subject to an inundation, and left in confused heaps. The implements were mainly wooden shovels, axe-handles, &c. Among the relics, also, was a basket made of untanned raw hide, a piece of cloth woven of coarse wool, the fibre of which is very even and still in good preservation, and a torch, bound together with flax-fibre. The probabilities are that the ancient salt-miners were overtaken by the flooding of the mine, as mummified bodies have been discovered also. The find seems to have belonged to the pre-Roman times, as the axe-handles were evidently used for bronze axes, specimens of which have been found upon the surface of the mountain. The relics are of a high order, the basket being superior even to some that were used in the early historic times.

IRON chessboards and chessmen, with concealed magnets to steady them on the board, are sold to travellers in Berlin.

THE recent Imperial decree relating to the precautions to be taken against fire in the Vienna theatres enacts that all theatres built from this date are to be completely detached. The stage is to be divided from the auditorium by a wall not less than 20 in. high and 18 in. thick above the roof, so that in case of fire the stage may be isolated from the rest of the house. The stage must be of sufficient height

for the curtain to be raised without being rolled. No one is to be allowed to live in the theatre, and the stage carpenter's shops, the stage appliances, and the refreshment bars are to be outside the theatre, this latter regulation to be applied to theatres already in existence. All the dresses worn by the actors and actresses are to be dipped in a preparation which makes them more or less fireproof, and no explosive matter is, under any pretence, to be left in the theatre. Very strict provisions are made with regard to the seating of the theatre, so that there may be plenty of room for easy exit, and the prefect of police is to have the power of deciding how many firemen shall be allotted to each theatre. The manager of the theatre is to be held personally responsible for the carrying out of all these regulations down to the smallest detail, and he will be severely punished if, upon the very first alarm of fire, he fails to give the public notice.

We note elsewhere that a deputation waited on Mr. Shaw-Lefevre, on Monday, with respect to the present disgraceful condition of Kew Gardens. The English, truly, are a patient people, or they would long since have put an emphatic end to what amounts to the appropriation of a valuable portion of the national property by the Hooker family. The gardens are bricked out of sight by a mile-long wall, and during the best hours of the twenty-four for garden scenery the real owners of the gardens are excluded by a system of administration which we should call boorish, if that were not altogether too mild a term to apply to what (when we consider how many thousands of our people are injured and robbed of their rights by it) can only properly be termed cruel and brutal. We shall return to this subject next week.

Bismarck objects to the displacement of German characters by the Roman letters used by other European nations. He would even stand by the ingeniously mysterious written characters which have apparently been invented to prevent foreigners from reading German letters or MS. One cannot well wonder that Germany has turned out some excellent readers of hieroglyphic and cuneiform inscriptions. Germans are trained in such work from their childhood upward.

Professor Tyndall, referring to our triumphs in Egypt (shades of Pitt and Fox!), says, after Tennyson, "Thank God, we are a people still!" This national feeling is an important factor in human progress, though science views it rather doubtfully. Our nation has had, perhaps, as worthy cause of pride ere now as Tel-el-Kebir gives. But *was* this the *people's* war? If it was, then the people should give their thanks. A journey to Balmoral may be acceptable to our men—or, stay, the men are not commanded to be commended—to our officers, after their return from Egypt. But a review in the park, with thousands to shout applause (if so be), would look more like a people's praise.

London College of Practical Engineering.—This college has just been opened at 162, Great Portland-street, London, W., to afford practical and systematic instruction in engineering. Actual workshop practice is to be its main feature, though not to the exclusion of theory. The college is under the superintendence of Mr. F. S. Pichler, C.E., formerly assistant to Sir Charles Wheatstone, and afterwards for many years the deviser of the mechanical novelties which distinguished the late Royal Polytechnic, including the famous life-size automata of Leotard and Blondin.

The Owens College, Manchester.—Professor Arthur Schuster, assisted by Mr. Gee, is announced to give a theoretical and practical course on the technical applications of electricity on Thursday evenings, in the Physical Laboratory. The syllabus is comprehensive, and embraces:—Current producers, current measures, telegraph construction, duplex and submarine telegraphy, telephony, magneto and dynamo-electric machines—description and comparison of different systems; electrical lighting, testing of strong currents and electro-motive forces, different systems of lamps, photometers, electromotors, electric railways, &c.

"The *Times*," says the *Photographic News*, "is acquiring quite a reputation for being behindhand with its news. Photographing from a train in motion is a feat it has just heard of, and probably next year we shall be told the operation can be performed on board a steamer as well. Our contemporary also speaks of a shutter moving so rapidly that 'only 1-100th of a second' exposure is given by it. Apparently the *Times* is incapable of conceiving anything faster than itself just now." Considering that five years ago Janssen claimed to give only the 1200th of a second exposure in his solar photographic operations at Meudon, the *Times* does seem rather behind the time.

Messrs. Sampson Low, Marston, & Co. are about to publish a cheap edition of the illustrated re-issue of Gilpin's "Forest Scenery," edited, with notes bringing it up to date, by Mr. F. G. Heath, author of "Autumnal Leaves." It is a curious fact that the existence of the third edition of "Forest Scenery," which was revised by Gilpin himself, and which forms the text of Mr. Heath's reprint, was unknown to Sir T. D. Lander, first editor of this famous work, and there is no copy of it even in the British Museum.

The National Portrait Gallery is to be re-arranged, the portraits now at the British Museum being added to the collection. The Gallery needs another change in the way of subtraction. It is an insult to every lady and gentleman in the country, to every Englishman and every English woman, that a National Portrait Gallery should include portraits of the female associates of royal iniquity. No man who has any respect for wife, or sister, or mother, or daughter, should cross the threshold of the National Portrait Gallery till these offensive pictures have been either removed or put in a room by themselves—a Bad Gallery, so to speak. Whoever put these women among our national "celebrities" might be duly honoured by being pictured in the same room. That persons descended from their brood should be in the House of Lords is an offence not now easily corrected: but we need not have pictures thrust before us (as *national*, save the mark) of those to whom the British nation owes this legislative insult. It is understood that the queen's sympathies are with those among the women of this country who are good and pure. She possesses influence. She should get the jades removed.

Mrs. Langtry sailed for New York on the 14th. American ladies did not welcome Mrs. Rousby very warmly at their "receptions." Yet she was not the worst actress England has sent across the Atlantic. One wonders how they will receive Mrs. Langtry.

Our space having been somewhat encroached upon this week, we shall have next week a thirty-two page number.

GEOLOGY OF LLANDUDNO AND RHYL.

By W. Jerome Harrison, F.G.S.

(*Continued from page* 306.)

The Carboniferous Formation.—Beds of the *Mountain* or *Carboniferous Limestone*, preserved by their position at the base of a synclinal curve, form Great Orme's Head; the change of dip from northerly to horizontal, and then to southerly, is well seen while taking a drive along the magnificent road of five miles in length which encircles the "Head." Little Orme's Head is a continuation of the same rock, while Llandudno lies in the gap between the two Heads, produced by the forces of denudation acting on strata thrown into an *anticlinal* curve, and thereby specially laid open to the atmospheric and marine forces.

Striking out to sea from Little Orme's Head and the corresponding headland on the south side of Rhos Bay, the Mountain Limestone curves round southwards beneath the water, and strikes the coast again at Colwyn Bay, forming the picturesque heights west of Abergele. From this point the limestone strata extend southwards in a long narrow line past Denbigh to the extremity of the Vale of Clwyd. But while the *strike* of the limestone beds is north and south, their *dip* is to the east. In this direction they disappear under the New Red Sandstone which forms the level surface of the Vale of Clwyd, to be brought up again by a fault which ranges along the eastern side of the valley and exposes the Limestone in several patches, as near Bodfari and Llan Vedr. At the north-east end of the Vale, the Mountain Limestone forms the hill called Moel Hiraddug, whence a line of hills runs eastwards to Prestatyn, and thence southwards, forming the hills that lie west of Holywell and Mold.

Everywhere the Mountain Limestone presents a similar appearance, as a thick bed of compact grey stone, the central portion being lighter in colour, or nearly white. Fossils are plentiful, especially in the higher beds, chiefly such marine shells as *Productus*, *Rhynchonella*, and *Spirifera*, branching corals called *Syringopora*, and the little cup-coral (*Cyathophyllum*); while the rings which were the joints of sea-lilies (*Crinoids*), lie thickly on almost every slab. In the quarries above Prestatyn I obtained many formidable-looking fish-teeth belonging to the genus *Rhizodus*. In the Minera district, further south, Mr. Morton has recognized four zones—Lower Grey, Lower White, Upper White, and Upper Grey—each characterised by certain fossils, in the Mountain Limestone, and any geologist who makes a stay at Llandudno or Rhyl should bear this fact in mind, and endeavour to trace these zones in his neighbourhood.

Many *lodes*, or fissures filled with metallic ores, are known. The most important of these is worked at Talargoch, about three miles south-east of Rhyl; it yields about 2,700 tons of zinc ore (value £12,000) and 900 tons of lead ore richly impregnated with silver (value £9,200), annually. The limestone itself is largely quarried for burning, for road-metal, and for building purposes.

Certain beds of red sandstone and conglomerate underlie the Mountain Limestone on the west side of the Vale of Clwyd; they occur in Ffernant Dingle, about one mile south of Llysfaen, also near Henllan. These beds have been mapped as *Old Red Sandstone* by the Survey, but I believe they are identical with similar strata known in the Lake District and in the Isle of Man, and that they form the base of, and belong to, the Carboniferous Limestone.

The Millstone Grit is well seen resting upon the Limestone at Gronant, Gwespyr, Holywell, and at many points west and south of Mold. There is a small patch of it in the valley south of Little Orme's Head, and another round St. Asaph. The lower beds are black and flinty-looking; they are a kind of *chert*, and are quarried at Gronant to be used in the Staffordshire Potteries; above these cherty bed come sandstones, not very coarse in texture, worked at Gwespyr and other places for building-stones, millstones, scythe-sharpeners, &c. Fossils, with the exception of plant-markings, are scarce. Further south, near Oswestry, the marine shells of the Mountain Limestone have been found to range high up into the Millstone Grit, and it would be a most interesting task for any geologist residing in the neighbourhood of Holywell or Prestatyn to endeavour to determine whether the same thing occurs further north.

The Coal-measures form a little coal-field along the Dee, at Flint and Bagillt; dipping under the river, the beds rise again on the Cheshire side, where there is a colliery at Neston. The possibility of the occurrence of coal-seams underneath the Vale of Clwyd has been considered, and in 1860 a bore-hole was made near the Foryd, close to Rhyl, which passed through the following beds:—

Alluvial Deposits, 54 ft.; Gravel and Clay.
Glacial Beds, 44 ft.; Red Clay and Sand.
New Red Sandstone, 500 ft.; Red Sandstones and Shales.
Carboniferous? 150 ft.; Red Marls and Shales.

Although it is a pity that the boring was not continued to a greater depth than 748 feet, yet the probability is *against* the occurrence of useful coal-seams in this district.

The Trias or New Red Sandstone.—The soft red sandstone which forms the level floor of the Vale of Clwyd represents the *Lower Bunter Sandstone* of the Midlands. Here, as elsewhere, it is quite unfossiliferous.

Glacial Deposits.—Nearly all the low ground of north-east Wales has a coating of what is called *Boulder Clay*, which is a reddish unstratified clay, containing an abundance of scratched stones of all sizes. This deposit creeps up the hill-sides to a considerable height, while higher still beds of gravel and sand are met with, also referable to glacial times. Many travelled blocks of granite are found along the coast, some of which can be identified with Lake-district rocks, having been carried southwards during the glacial period by glaciers or icebergs. The smoothed and rounded (*moutonnée*) outlines of the hills (best seen from a distance), clearly tell of the passage of a heavy mass of ice over the district. Considered in this light, a study of the pebbles on the beach will be found interesting; at Rhyl, since the town stands on a dead alluvial flat, this will be the only use to which a geologist can put his hammer; an examination of the low sand-hills which here fringe the coast will, however, show him the geological phenomenon known as "false-bedding" in perfection.

Pre-historic Man.—Owing to the absence of flint, the hills are not so productive of weapons fashioned out of that (to savage tribes) favourite material as the Downs of Yorkshire or Sussex. There are, however, numerous well-preserved remains of tumuli, camps, and hut-dwellings. Caves are not unfrequent; the best known is situated at Cefn, about two miles south-west of St. Asaph, half-way up a vertical limestone cliff 300 ft. high, overlooking a grand ravine cut by the river Elwy. Here flint and stone implements, with many teeth and bones of certain extinct animals, have been found embedded in the stalagmitic floor.

From these brief notes it will be seen that in this region there is much for the beginner to learn, and many problems which an experienced geologist might render aid in solving. My difficulty has been to compress a notice of even the principal facts into the necessarily restricted limits of this article.

XUM

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT.—IV.

HAVING explained the Volt and the Ohm, we now come to a question equally important, but perhaps a little more intricate, viz., the *strength of the current.* The unit strength is called an Ampère, and is that amount of current resulting from an electro-motive force of one Volt passing through a total resistance of one Ohm. By the total resistance is meant the resistance of the battery as well as the wire; and whatever instruments may be in the circuit, so that the ordinary Daniell cell, while it has an E M F (electro-motive force) of about one Volt, will not produce a current of one Ampère, because the resistance of the cell is more than one Ohm; it is, in fact, about ten Ohms. Such a cell, having its poles connected by a short thick strap of copper, would give a current equal to one-tenth of an Ampère. This is best seen by reference to the world-famed Ohm's Law. By some mysterious means this law, doubted and denied for half-a-century, now fully borne out by experiment and accepted by every electrician, is by the tyro or the student regarded with feelings somewhat akin to awe, whereas it is in reality one of the simplest, most beautiful, and most universally applicable in the whole range of scientific inquiry. This great law is expressed by

the equation $$\frac{E}{R}=C.$$

or, in other words, the electro-motive force (in Volts) divided by the resistance (in Ohms) gives us the strength of the current (in Ampères). The resistance embraces, as we said, all resistances in the circuit.

We will endeavour to simplify matters by taking a few examples. The resistance of a Daniell cell being 10 Ohms, 10 cells will offer 100 Ohms, 50 cells 500 Ohms, and so on. By joining the two ends of our battery together by means of a short piece of thick wire, so as to offer practically no external resistance, we shall get

with one cell $$\frac{E}{R}=\frac{1}{10}=\cdot1$$

with 10 cells $$\frac{E}{R}=\frac{10}{100}=\cdot1$$

with 50 cells $$\frac{E}{R}=\frac{50}{500}=\cdot1$$

and so on, showing that we get in each case ·1 of an Ampère, and that to all intents and purposes one cell is as good as 100 cells. If, however, we insert resistance in the external circuit, in the form of a telegraph wire and instruments the result will be very different. Suppose we have a line offering 100 Ohms. Then, letting R=the resistance of the battery, and R′=the resistance of the line, we get

with one cell $$\frac{E}{R+R'}=\frac{1}{10+100}=\cdot009$$

with 10 cells $$\frac{E}{R+R'}=\frac{10}{100+100}=\cdot050$$

with 20 cells $$\frac{E}{R+R'}=\frac{20}{200+100}=\cdot066\dot{6}$$

with 50 cells $$\frac{E}{R+R'}=\frac{50}{500+100}=\cdot08\dot{3}$$

In the first two instances the strength of the resulting current increases considerably with the number of cells employed, but in the two latter cases this proportion is not maintained, owing to the relative reduction in the value or importance of the line resistance. Taking a longer line, say London to Newcastle, offering 5,000 Ohms, including 300 Ohms for the resistance of the receiving apparatus, we get

with 10 cells $$\frac{10}{5000+100}=\cdot00196$$

with 20 cells $$\frac{20}{5000+200}=\cdot00384$$

with 50 cells $$\frac{50}{5000+500}=\cdot009\dot{0}\dot{9}$$

with 100 cells $$\frac{100}{5000+1000}=\cdot01666$$

The increase in the strength of the current is now seen to be advancing nearly in proportion to the number of cells. The ratio would be more striking if we were to take the cells actually in use for long telegraph lines, offering only 2 Ohms resistance per cell. Thus we get

with 10 cells $$\frac{10}{5000+20}=\cdot00199$$

with 100 cells $$\frac{100}{5000+200}=\cdot01923$$

These simple calculations demonstrate, then, that so long as the external resistance exceeds that of the battery, it is economically advantageous to increase the number of cells joined in succession or series.

We come next to consider the case in which we have a low external resistance, but our electrical effect being too small, we want to increase the current. How shall we do it? Our first examples demonstrated that we could not advantageously increase the cells in series. It is clear that the only way by which we can accomplish this is to reduce the denominator of $\frac{1}{10}$, or, in other words, reduce the resistance of the battery. This can be done by increasing the size of the plates, and so bringing a larger amount of surface into action. That this should be so, will be apparent if we can bring ourselves to look upon the cylinder of water between the plates as a wire. Then if we double the area of the plates we double the sectional area of the cylinder of water between them, and "the resistance of a conductor varies in the inverse proportion to its sectional area." Supposing the 10 Ohms cell to have plates offering 6 square inches of surface to the liquid, a cell with 12 square inches will offer only 5 Ohms. Here, instead of getting a current

$$\frac{E}{R}=\frac{1}{10}=\cdot1$$

we should get $$\frac{E}{R}=\frac{1}{5}=\cdot2$$

that is to say, twice as strong. It would, however, be very inconvenient in many ways, were it necessary to resort to such a process. The same result can be obtained much more easily by the process generally known as joining up for "quantity." It consists in connecting the zinc or positive plate of one cell to the zinc of another, and likewise joining the two negative plates together. Fig. 2 will illustrates this. B′ and B″ are two batteries, each consisting of 5 cells, the short thick strokes representing the zinc plates, and the long thin ones the copper plates.

The terminal plates C C on the right side are connected by a piece of wire; Z Z on the left side being similarly connected. When batteries are joined up in this way they should consist of equal numbers of equally efficient cells, otherwise there will be a tendency of the current from the stronger battery to run through the weaker, and soon render it useless. Wires are fastened at E and F and joined to whatever apparatus the current is required for. Suppose we wish to send it through a Galvanometer G, made by winding a few turns of thick wire round a magnetic needle. The external resistance in this case will be practically *nil.* Consequently the deflection of the needle

will, if the E M F remains constant, vary in strength with the resistance in the battery. Thus supposing a battery of 5 cells in series yielding a current of ·1 Ampère to produce

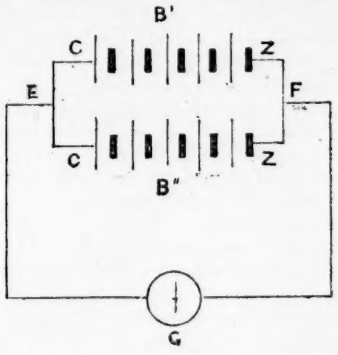


Fig. 1.

a deflection of 5°, two such batteries placed side by side as in Fig. 1, will yield ·2 Ampère and produce a deflection of 10°. The equation in the second case becomes

$$\frac{5}{25}=\cdot 2$$

because in adding the second battery we practically double the size of the original cells, and so halve the resistance. The E M F is not affected, as the energy or potential of the current is independent of any variation in the size of the plates.

This topic will be resumed in our next.

NIGHTS WITH A THREE-INCH TELESCOPE.

By a Fellow of the Royal Astronomical Society.

(*Continued from page* 311.)

IF the reader will fish with a power of 70 or 80 between β Cygni and Delphinus, some 7° south-east of the former star, he will strike upon that very curious object, 27 Messier, Vulpeculæ—the so-called "Dumb Bell" nebula, of which ridiculous pictures appear in certain works on popular astronomy. We have done what we could to present a portrait of this nebula in Fig. 56.

Fig. 56.

27 M. Vulpeculæ.

Fig. 57.

μ Draconis.

Fig. 58.

ε Draconis.

The sprawling constellation Draco, which straggles over so much of the circumpolar sky, is our next in order for examination. From its situation the amateur can scarcely expect to scrutinise many of its chief objects in succession without getting a back-ache, and a stiff neck to boot, so inconveniently are they placed. Let us, however, express a hope that the intellectual pleasure to be derived from such a search may quite outweigh its concomitant physical discomfort. If we draw a line from γ Draconis, through β, and carry it on twice the distance between them, we shall strike 17 Draconis, a pretty and interesting triple. μ Draconis, a close but easy pair, is shown in Fig. 57. Rather more than 1½° south of β Draconis is a small but very pretty double star, 147 of Piazzi's hour XVII. It is invisible to the naked eye. If we draw a line from the Pole Star to γ Draconis, and fish on it, about half way between those stars, with a low power, we shall light upon that strange object, Herschel 37, IV., Draconis. This is the nebula which our greatest living English spectroscopist, Dr. Huggins, found to be gaseous, in 1864. Viewed in the instrument employed for the purpose of these papers, it presents the appearance of a large pale blue star out of focus. South-east of ε Ursæ Minoris 40 Draconis will be found. It is a wide and easy pair. 39 Draconis, half-way between γ and δ, appears in the books as a triple star. It will require an extremely fine night and a high power, however, to show the *comes* to the principal star, whose light and proximity quite overpower it; so that it will ordinarily appear as a very wide double only, in a three-inch telescope. ο Draconis is a wide pair, but the colours are very pretty. The last object in this constellation which we shall look at to-night, ε Draconis, will form a severe test, at once for the observer's instrument and his eye, and for the state of the atmosphere. He must employ the highest power at his command, and even then the companion will often be involved in the diffraction ring surrounding the larger star. Fig. 58 gives an idea of this star when caught at moments of the best vision.

EARTHQUAKES IN THE BRITISH ISLES.—I.

DR. MILNE, recently returned from Japan, notes that men in England pay less attention to earth tremblings than they merit, though we have no such reason for noting them as they have in Japan. We are, however, all interested in the question whether this, our country, is liable—even at long intervals of time—to the influence of destructive earthquakes. We know that there are countries which seem as firm and unshaken as our own is wont to be—countries which have remained for centuries undisturbed by any save the faintest indications of earth-tremor, which have yet been suddenly visited by those fierce throes which hurl in a few minutes the largest and best built cities to the ground. We ask ourselves whether the inhabitants of Lisbon could have felt less secure than we ourselves do of immunity from serious danger? Yet we know that without warning, that large city was made in a few moments a mere heap of ruins, in and around which lay the unburied bodies of sixty thousand of her inhabitants.

We often have had evidence that our country is, at least, not wholly unaffected by the action of subterranean disturbances. An area one hundred and fifty miles long and some seventy miles wide—possibly much larger—was disturbed only some twelve years ago by a smart shock of earthquake. The effects produced by the shock were not very remarkable—indeed, when one compares them with the effects of the late earth-throes in Panama, British earthquakes generally remind us of the old line,

"Montes parturiunt, nascitur ridiculus mus."

The solid foundations of England may be shaken, with no more remarkable results than the disturbance of a few people in bed at the time, noises "resembling the scurrying

of rats or mice across the room," rattling of crockery-ware in a cupboard, "as though a cat were shaking a shelf," and so on. Yet *there* the earthquake is, and it is quite possible that the force which actually produces the disturbance is one of tremendous energy. For it is an unsound argument to point to the effects which may be produced by ordinary surface shocks. It is true that the fall of a building, the explosion of a magazine, and even the passing of a vehicle, will shake the ground. But the conclusion often drawn from these facts—namely, that an earthquake may come of very slight and local causes—is unsound. A shock which is felt over half this island comes from no slight cause, and is in no way comparable with disturbances which are experienced over an area of but a few miles at the outside, as when a powder magazine explodes. The subterranean source of these wide-spread quiverings of our stable English ground are, we may be sure, deep-seated and energetic, even if it underlies immediately the region in which its action is felt. But if, as is probably the case, the throe is propagated from a distant source, and comes to the surface, so to speak, in our western counties, it may be comparable in energy, for aught we know, to some of those violent subterranean heavings which have worked the most terrible mischief to the human race.

Indeed, we have good reason for believing that the earthquakes felt in England belong to the same system, and come from the same centre of subterranean action, as those which have shaken Portugal, Morocco, and Algiers, Southern Italy, Turkey-in-Europe, and Asia Minor. There is a peculiarity about the British earthquakes which is well worth noticing, and seems to be explicable in no other way. Three hundred earthquakes and upwards have been recorded as having shaken these islands, and it has been found that in nearly every instance the wave of disturbance has travelled in the same direction. This direction is (roughly) from south-west to north-east, and the seat of disturbance thus indicated is that submarine region between the Azores, Teneriffe, and the Cape Verde Islands, which is looked upon as the principal source of the greater European earthquakes. Precisely as the last of the great earthwaves which devastated Peru came sweeping in from the Pacific, so the throes which destroyed Lisbon in 1759 swept in from the west. And though there are other sources of disturbance in the South-European volcanic district, yet it has been the opinion of the most eminent geologists that these all communicate with the source underlying the western Atlantic, and that the latter source is the most deep-seated and therefore the most important of them all.

We proceed to give a brief account of the most remarkable evidences which these islands have afforded of the energy of subterranean forces, either acting immediately beneath them, or propagated along deep-lying channels from the far distant seat of disturbance which we have indicated.

Some of the earlier earthquakes of which records have been handed down would seem, if the accounts can be trusted, to have been much more important than those which have recently taken place. Wendover relates that in 974 the whole of England was shaken by a great earthquake; and the earthquake of 1081 was accompanied, we are told, by a tremendous roaring noise—"a heavy bellowing," as one chronicler says—which was heard throughout the length and breadth of the land. In the Saxon chronicle it is stated that there was, in 1089, "a mickle earth-stirring over all England?" A somewhat remarkable effect was ascribed to this earthquake. It happened that the harvest was very backward in that year, and it was supposed that this was due to the earthquake, as though perhaps the seeds had been shaken somewhat down from their original place, and had so taken a longer time in attaining maturity.

A very singular event occurred in 1110. During the occurrence of a very sharp shock of earthquake at Shrewsbury, the River Trent was dried up at Nottingham "from morning to the third hour of the day," says the narrator, Florence of Worcester, "so that men walked dryshod through its channel."

We are now approaching a period when the most remarkable earthquakes which have ever been known in England were experienced. In 1133 a great earthquake was felt over a large part of Great Britain. In 1165, according to Matthew Paris, "there was an earthquake in Ely, Norfolk, and Suffolk, so that it threw down men who were standing, and rang the bells." In 1185, shocks were felt which were so violent that Lincoln Cathedral was flung down, and an immense amount of mischief was worked in that and neighbouring counties. Two years later there happened another earthquake, in which, according to Matthew Paris, many buildings, and some which were strong and well established, were thrown down.

If we are to believe Matthew Paris, the earthquake which took place in 1247 was attended by some very noteworthy phenomena. He relates that the shock was experienced with especial violence on the banks of the Thames, where many buildings were flung to the ground. But the singular feature of the event was that, a few days after, the sea became unnaturally calm, as if the tides had ceased, and so remained for about three months. It seems difficult, however, to associate the two events together in any way; and doubtless the calm of the sea, though it may have been remarkable, is to be ascribed to ordinary causes. Possibly the character of the phenomenon has been much exaggerated.

In 1248, the western parts of England were shaken with an energy far exceeding anything which has been known in recent times. Wide rents were opened in the churches of the diocese of Bath, and a portion of the tower of Wells Cathedral was flung down and fell through the roof. The cathedral at St. David's was also seriously damaged.

But from all accounts, it would seem that the earthquake of September, 1275, the last of the series of events which belonged to the epoch we have referred to above, was the most remarkable of them all. Matthew of Westminster relates that "by the violence of this earthquake the church of Saint Michael of the Hill, outside Glastonbury, fell down levelled with the soil." And it is said that many of the largest churches in England were destroyed or greatly injured by the same shock.

It is rather a singular circumstance that this period of activity was associated with an interval during which Mount Vesuvius was remarkably quiescent. After the eruption of 1049, ninety years passed, during which the mountain was not disturbed, and then another long rest of 168 years. That this repose was not due to any intermittence of subterranean action is clear from the fact that the volcanic district around Vesuvius was forced into unusual activity—as if an effort were made in this way to compensate for the temporary cessation of the great crater's activity as an outlet of discharge to the elastic fluids and lava which are formed during subterranean disturbances. It is related that the Solfatara Lake was in eruption, and the volcanic island of Ischia, which had been at rest for fourteen centuries, was roused into so active a state that in 1302, after many heavings, the island gave vent to a lava-stream of enormous dimensions. This stream flowed for a distance of two miles.

It may seem startling to many to find earthquakes in

England associated with the movements of so distant a volcano, but we shall see as we proceed that there is good reason for believing that an association of this sort actually exists. Very few geologists doubt, indeed, that Vesuvius is connected with the region of disturbance we have already referred to as the probable centre whence English earth-waves have been propagated.

THE COMET.

By the Editor.

(*Continued from page* 328.)

IF we are right in concluding that the comet which passed its perihelion on Sept. 17 is the same body which was seen in 1668, 1843, and 1880, the inference unquestionably is that the comet will before very long be destroyed by being absorbed into the sun. Let us inquire how this process of absorption, or such a process, would take place. I find that very erroneous ideas are commonly entertained on this subject. It is supposed by many that each successive return must of necessity produce greater and greater effect; and again, that the action by which the orbit is changed from a long oval to a circle is that which must in most marked degree affect the comet's physical condition. But the reverse is, in both instances, the case. Theoretically the effect at each return to perihelion ought to be less and less in the comet itself, and diminish its period and the length of the greater axis of its orbit in less and less degree; and again, the effects produced on the comet's physical condition by solar action will theoretically be enormously greater after the orbit has been changed to the circular form than they are now while the orbit is elliptical.

Let us, in the first place, consider the varying velocities of the comet at its point of nearest approach to the sun, this point—the perihelion—remaining unchanged in position, but the greater axis and period diminishing.

The formula for the velocity at any point in an elliptic orbit is as follows:—

$$V^2 = C\left(\frac{2}{r} - \frac{1}{a}\right)$$

where C represents the accelerating force of the sun at a unit of distance, a the mean distance or half major axis of the orbit, and r the distance of the body at the moment.

Suppose now that the distance of our comet from the sun's centre, in perihelion, is half-a-million of miles, or roughly, one 185th part of the earth's mean distance, and note that a body moving in an orbit having an infinite major axis and perihelion 430,000 miles from sun's centre would travel at a rate of 380 miles per second. Thus we have $(380)^2 = C\frac{2}{430{,}000}$ and if V is the velocity with which our comet, coming originally from a practically infinite distance, reached its perihelion on its first visit to our solar system, we have

$$V^2 = C\frac{2}{500{,}000}$$

wherefore $$V = 380\sqrt{\frac{43}{50}} = 380\sqrt{86} = 352.$$

Let us find now a general formula connecting the velocity u at distance r in a parabolic orbit with v the velocity at distance r in an elliptic orbit, having mean distance a. We have

$$u^2 = c\frac{2}{r} \text{ and } v^2 = c\left(\frac{2}{r} - \frac{1}{a}\right)$$

$$\therefore \quad \frac{u^2}{v^2} = \frac{2}{r} \div \left(\frac{2}{r} - \frac{1}{a}\right) = \frac{2a}{2a-r}$$

and so long as r is very small compared with a we have

$$\frac{u}{v} = \frac{4a}{4a-r}; \quad \frac{u-v}{u} = \frac{r}{4a}; \quad \text{or,} \quad u - v = \frac{r}{4a} \cdot u$$

This is a very convenient formula in the case of our comet, for we have in this case $u = 352$ (miles per second). Thus, suppose the mean distance a reduced from infinity to 3,000,000,000; then velocity in perihelion (at 500,000 miles from sun's centre) is less than this by

$$\frac{5}{120000}(352) \text{ or by } \frac{352}{24000} \text{ miles per second,}$$

i.e., by less than $\frac{1}{68}$th of a mile, or 26 yards per second. This is all the reduction of velocity in or near perihelion required to change the orbit from the parabolic form to an elliptic orbit, having a mean distance rather greater than Neptune's, and a period not very different from the time occupied by the comet in returning after its visit in 1668. For, putting 1843 as the time of its next return, and, therefore, 175 years as its time of circuit, we find the mean distance corresponding to this period to be $\sqrt[3]{(175)^2}$. Here is a case for the use of logarithms: (for who wants to square 175, and then work out the cube root of the result? Not I, certainly; but)—

log. 175 = 2·24304

2

3)4·48608

1·49536 = log. 31·287

showing a distance 31¼ times the earth's, or about 2,910 millions of miles.

Next, let us see what reduction would be necessary to reduce the mean distance to 1,000 millions of miles. The same process shows that the loss of velocity is

$$\frac{5}{40000}(352) \text{ or } \frac{352}{8000} \text{ miles,}$$

i.e., about three times as much as in the former case, say 78 yards per second, which means a further loss of velocity at this next perihelion passage of about 52 yards per second. This corresponds nearly enough with the period of 37 years, in which the comet seems to have performed its next circuit,—between 1843 and 1880. For we get in that case for the mean distance $\sqrt[3]{(37)^2}$: whence the sum

log. 37 = 1·56820

2

3)3·13640

1·04547

add log. 93,000,000 = 7·96848

9·01395 = log. 1,032,000,000.

So that if the comet came out from a practically infinite distance, and were retarded during perihelion passage by only 26 yards, it would circuit next in a period of 175 years; and if at its next return it lost only 52 yards per second *more*, it would complete its next circuit in 37 years, or thereabouts.

But now, what would be its velocity in perihelion, if it travelled once round the sun in 2⅔ years, its perihelion distance of 500,000 miles being unaltered? The mean distance corresponding to this period will be $\left(\frac{8}{3}\right)^{\frac{2}{3}}$ times the earth's.

$= \sqrt[3]{7·111}$

Now log. 7·111 = 0·85193

⅓rd of this = 0·28398

Log. earth's distance = 7·96848

8·25246 = log. 178,840,000.

Thus the mean distance of the comet during its last circuit was no less than 178,840,000 miles, its greatest distance nearly twice this, or, roughly, about 357,000,000 miles.

The velocity in perihelion corresponding to this mean distance is less than the velocity per second with which the comet first reached perihelion, by

$$\frac{50}{71,536}(352) \text{ or by } \frac{35,200}{143,072} \text{ miles.}$$

This is about a quarter of a mile or more, exactly 410 yards per second, a reduction of velocity much more important than either of the former two, but still small enough compared with the velocity actually possessed by the comet in perihelion. The actual reduction from that at the preceding perihelion passage is (410−78), or 332 yards.

A still larger reduction in the velocity at perihelion would be required to reduce the period from two years eight months, to one year. For with the latter period the reduction of velocity in perihelion from that due to motion in a parabolic orbit would be

$$\frac{5(352)}{4\times 930} \text{ or } \frac{44}{93} \text{ of a mile per second.}$$

This is about 833 yards per second, or a reduction from the velocity at the preceding perihelion passage by

$$833-332 = 501 \text{ yards per second.}$$

There is reason to believe that a more important reduction than this took place—in which case the comet will be back in less than a year.

SCIENCE OF *THE TIMES*.

SCIENTIFIC articles in *The Times* are generally worth reading, for the same reason that the Spartan helots, when disguised in liquor, were worth watching—to wit, as awful examples. But there are degrees, even in such cases as these. Under what conditions, we wonder, can the following sentences from an article on earthquakes have been written?—"When the earth was conceived to be a crust floating on a sea of liquid fire, observation alone, and not experiment, seemed applicable to the storms which tossed and blasted the superincumbent mass. The ocean of molten lava resembled a capricious monster, which obeyed impulses incomprehensible to the sufferers by its fretful fury. An earthquake, according to the more recent belief, which Mr. Mallet's reasonings and illustrations have raised to the level of a law, is but a variety, gigantic in its proportions, of a process always in operation, and among the regular machinery for the action of nature." [Did anyone ever read such English?] "The earth is perpetually breathing and sighing throughout its whole frame. Its throbs cause a succession of minute motions as penetrating as the labours of earth-worms, and as effective. Somewhere about the stupendous mass a similar species of movement is ever manifesting itself with a larger volume in the form of oscillations. . . . . As Professor Milne remarks, in the origin of the astonishing ebullitions called earthquakes principal are usually modified by secondary causes. . . . . The object of Professor Milne's letter is to urge the claims of seismology to fuller recognition in countries *which neither can boast nor have cause to dread the earthquakes of the Pacific.* Phenomena, he points out, are present in unfailing and unvarying abundance within these more temperate regions. They wait or they come back to be inspected with a patience and a regularity unknown in the resorts of earthquakes. Modern science has no inclination to tolerate that the earth should be suffering incessant modifications without inquiring what they are and how they are accomplished. Nature and its acts and faculties have too complete an unity for science to possess any option of neglect were it disposed to be neglectful. *The microseismic motions and the oscillations to which Mr. Milne refers, if they are part of the ordinary economy of nature, must mix with and affect all the rest of its departments. Even for the purposes of experiment, it is impossible to 'bury' or 'eat them up.'* The sole remedy is to consult them. The field has as yet few explorers. Its conditions of exploration and the attainable results are hypothetical. An extraordinary assemblage of phenomena is sure to reward the early pioneers. They have a new world before them. But nature, the more multiform its energy and manner of working, shows itself only the more uniform at heart. Its laws are as simple as their agencies are complex. *Science dissipates mysteries at the moment of grasping them. When the recesses of the earth are probed they will be found to hide no dark secrets defying tests and arrangements.* The same analysis which promises to reduce earth tremors to a system, and display by what physical instruments they are produced, may supply a clue to the portent of an earthquake. *Nature is as impatient of monstrosities as science. When nature and science are labouring together apparent physical anomalies are very speedily smoothed out and effaced.*"

Comment on inanities such as these would be idle. We have italicised the most salient absurdities, but there is little to choose between these and the others, or between the passages we have quoted and the rest of this scientific "leader." If these are our leaders, heaven help the led. Yet many wonder that "the general reader" is not attracted by science. How should he be when it is presented in such garb as this?

A HINT TO BOTANISTS:

OR LEAF COPYING.

IN reading the interesting account on the method of taking the impression of butterflies' wings, which I have often myself practised, I recalled a very simple, though excellent, plan for taking the impression of leaves and flowers which I think is not generally known, and which I intend to describe so that our entomological friends may not have all the advantage over our botanical scientists. In the first place procure a small bottle of oil (I always use olive), a camel's-hair brush or piece of rag, half-a-dozen sheets of white unruled copying paper, and a few sheets of white notepaper, also a good old-fashioned tallow candle with a large wick; having placed these articles ready to hand, commence operations by taking the leaves you wish to perform upon and putting them under a press, if you possess one, or put them in a large book so as to get them with a fairly even surface; then take a large sheet of your copying paper and oil it completely by rubbing it with your rag, taking care not to put on more oil than is necessary; this oiled paper must then be placed in a good draught or in the open air till it is fairly dry* (as otherwise the impression will be faint). When it is ready, light your homely tallow, and taking the corners of your oiled paper, hold it over the candle so that the flame just touches it, moving it about to prevent it from scorching. Do this until a fine layer of carbon is deposited on the paper, thick enough to only just see the light of the candle through the paper as

* You can, of course, always keep some ready, as it takes about two or three hours to get moderately dry.

you hold it over it. Be careful that the paper is equally black all over, as otherwise the impression will be blotchy. When you have done this, extinguish your candle and place your prepared paper on the table, black side uppermost. Then take your leaf on which you are going to perform, and, cutting out a piece of black paper of that size, place the leaf upon it; then, over that, place another sheet of paper, and with your finger rub carefully and evenly over the place where the leaf is, taking care not to shift its position. After this, lift off the top paper, and carefully raise your leaf from the blackened paper on to a sheet of white note-paper, and, when once you have laid it on, do not move it in the least, or it will smear; then, placing a clean piece of paper to cover the leaf, again rub well, and quite evenly, over where the leaf lies, for about two minutes; then remove your paper and leaf and you will find a beautiful impression of the leaf, with all the veins, even to the most minute, standing out in black. If this is allowed to dry it will not smear in the least, and will always retain its original freshness.

I do not suppose that my explanation has been very clear, but I have tried to make it as plain as possible. I have seen a very beautiful collection of flowers and leaves done by this method, and when they are arranged in groups or various forms, according to taste, they produce a very pretty effect. Some think tinting them with colours also very effective, but that is as your fancy may dictate.

J. F. Roberts.

Electrotyping Telegraph Wires.—The Postal Telegraph Company of New York have recently acquired an electrotyping establishment in Ansonia, Connecticut, for the purpose of covering the steel wire they employ with a deposit of copper. The present capacity of the works is sufficient to deposit two tons of copper a day, and extensions are now in progress to treble this amount. When these extensions are completed, 980-horse power will be employed to drive dynamo machines for supplying the current necessary to cover thirty miles of wire a day, with 500 lb. of copper per mile.

On Monday a deputation waited upon Mr. Shaw-Lefevre with reference to the restricted facilities for entrance to Kew Gardens. The deputation complained that not only were the public excluded from the gardens every day until after 1 o'clock, but the Temperate-house gate, close to the very handsome picture gallery, recently presented by Miss North, was being bricked up, and another entrance made 350 yards further down the road towards Richmond. It was pointed out that a large number of houses, ranging in value from £100 to £300 per annum, had been erected near the Temperate-house gate, and a new road made leading from the railway station to it, in the hope that it would be opened to the public, but the new gate would be at a spot where there was no population, and would give access to the least interesting part of the gardens. Mr. Shaw-Lefevre informed the deputation that the work was being carried out on the recommendation of Sir Joseph Hooker, the director, who had represented to the Department that it was for the public advantage. It was not desirous to multiply the entrances to the gardens. It was intended not only to brick up the Temperate-house gate, which had never been open to the public, but also to close the entrance now available for the public near Richmond, opening instead the new gate, which would be very ornamental, between the two. He would consider whether railings could be substituted for bricking-up the Temperate-house gate, so as not to shut out the view from the road. [Why not railings all along?—Ed.]

Reviews.

MAGNETISM AND ELECTRICITY.*

Electrical science and its applications have forced themselves so prominently before the public during the past few years, that it is only natural we should observe a considerable increase in the number of publications issued with a view to giving more or less reliable information to those who desire it, or, we may rather say, to cultivate a more extensive taste for it. Amongst the class-books designed for the use of those who, having no previous knowledge of the subject, are anxious to make themselves practically acquainted with its many mysteries, we know of no better than the little work now before us. Dr. Wormell has already gained a well-merited reputation in the world of physical science, which cannot fail to be increased by this, his latest effort. He aptly points out in the preface that "the general purpose of science in education is to cultivate in the student an intelligent attitude of mind in relation to the things and phenomena about him, and to give him ability to describe as well as to examine and use them." The author has, therefore, taken considerable trouble to incorporate an excellent series of instructions in laboratory practice, and has thereby assigned to the work a place by itself. The practice is designed mostly with apparatus of an extremely inexpensive but very efficient kind, and such as can generally be made by the student. The book is divided into a number of "lectures," each one dealing with a special branch, the lectures on Magnetism being uniformly good, and several of the experiments of a very telling but simple nature. Terrestrial magnetism and its effects upon iron ships, with the means devised for the "correction" of their permanent and temporary magnetisations, are very ably dealt with, and the dangers that would accrue were such corrections neglected, are pointed out and illustrated. In the lectures on Electricity, the studious combination of hand and head-work is continued, the experiments growing in interest and importance; but perhaps the best portions of the book are those which deal with measurements and instruments for measuring—best, not so much because of their superiority over the other chapters or lectures, but rather because there has hitherto been far too strong a tendency to ignore that branch of the science which entitles it to a place amongst the exact sciences. The lecture on "Capacity and Potential" is an unusually clear and concise exposition of what appears to be to the student one of his greatest difficulties. It makes the important relationship existing between capacity and potential so easily comprehensible, that no further trouble with the subject should be experienced. Careful attention has also been devoted to the explanation of the principles involved in magneto and dynamo-electric machines, as well as telephony and other applications of electricity.

The work is almost free from errors. There are, however, a few—possibly printers'—mistakes in the telegraphic characters, and it is to be regretted than an instrument which has been out of date these last twenty years should be given as an illustration of the Morse telegraph instrument of to-day. A more serious error has crept in on page 134, where, using a Galvanometer of low resistance, it is stated that cells being added in series to increase the electro-motive force (E. M. F.), "the current (c) is proportional to the E. M. F. producing it, or . . . . C varies

* *Magnetism and Electricity. An Elementary Text-Book for Students.* By Richard Wormell, D.Sc., M.A., Head-Master of the City of London Middle-Class Schools. (London: Thomas Murby.)

as E." This is only true when the external resistance is greatly in excess of the internal resistance. The error is, however, corrected further on in the excellent lecture on "Resistances."

Altogether the book commands a front rank amongst elementary text-books, and is well worthy of our recommendation. It is written in language which is simple but to the point, and our praise is due for the manner in which so much reliable information has been intelligibly compressed into so small a compass.

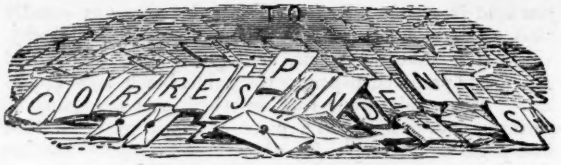
THE ELECTRIC LIGHT AT WATERLOO HOUSE. — The extensive premises, situated at the corner of Cockspur-street, in the occupation of Messrs. Halling, Pearce, & Stone, have just been fitted with sixteen arc lamps by the Metropolitan (Brush) Electric Light Company, the motive power being derived from a 12 horse-power (nominal) Otto gas-engine.

WE shall have Hampden and the three-headed Parallax (Goulden-Birley-Rowbotham) upon us. The daily papers tell the following story:—"An interesting experiment in signalling by sunshine has been made by our army in Egypt. Colonel Keyser ascended one of the Pyramids near Cairo, and setting up a heliographic mirror, reflected a ray of sunshine all the way to Alexandria, a distance of some 120 miles. The signals, appearing like pin-points of brightness, were distinctly readable on the coast, and took the form of a message from Sir Garnet Wolseley to the Khedive." The distance is scarcely 120 miles; nearer 110: but taking six inches for the depression in one mile from earth-curvature, corrected for refraction, we find for 55 miles a depression of more than 1,400 feet; so that a tangent to the earth's surface at a point midway between Alexandria and the Pyramids, would pass 1,400 feet above each of those places. Thus, if the mirror were 1,400 feet above the sea-level at the Pyramids, it might have reflected sun-rays to a point 1,400 feet above the sea-level at Alexandria. But a less height at either end would not serve, or if there were a less height at one, then there must be a greater height at the other.

ELEMENTS OF THE COMET.—As we expected, Dr. Hind's elements of the new comet, as given in our last number, have had to receive considerable modification. Instead of making the logarithm of the perihelion distance 8·09201, he makes it now 7·90653. The effect of this on the estimated perihelion distance in miles may be seen from the two following little sums:—

10+log. perihelion distance	=8·09201	or 7·90653
log. earth's distance	=7·96848	7·96848
	6·06049	5·87501

These logarithms correspond to a perihelion distance of 1,115,000 miles and 750,000 miles respectively. We believe the distance we adopted, viz., 500,000 miles, is nearer the mark. At any rate, this approach by 365,000 miles to our estimate is satisfactory. Dr. Hind remarks that his later elements afford indication of disturbance of the comet's motion near the time of passage through perihelion. It can be shown from his elements that, at the time when Mr. Gill saw the comet touching the sun's limb (the edge of the sun's disc), it should have been projected more than 5′ within the limb. It follows that the comet was much retarded during perihelion passage, as we shall show more particularly next week. All yet known about the comet tends to show that the comet of 1668, of 1843, of 1880, and of 1882 are *one*, and that at the place of nearest approach to the sun this comet is very seriously disturbed.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE: *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

SATURN'S RINGS.

[592]—As I am interested in the inquiry which has been made respecting the discovery of the primary division in Saturn's ring, will you kindly inform me where the copy of *Philosophical Transactions*, vol. i., which contains that drawing of the planet of which you have given a representation in KNOWLEDGE, No. 49, p. 307, can be seen, or in whose possession it is? A friend of mine has examined no less than seven copies of the said volume, and has not been able to find it. C. L. PRINCE.

The Observatory, Crowborough Beacon,
Tunbridge Wells.

[MR. T. WARD, who kindly sent to us the extract to which Mr. Prince refers, will, we have no doubt, communicate the particulars required. The extract is (Mr. Ward writes) "from the first volume of the *Philosophical Transactions*, not the condensed or epitomised one which was referred to by Captain Noble, but the original issue that came out in monthly parts." Mr. Lynn remarks in the *Athenæum* on the difference between the picture, of which Mr. Ward has supplied a *fac-simile*, and the one professing to be a copy of it, "so that some carelessness was committed in reproducing it." It seems clear that the engraver carefully removed the very feature which Ball had been careful to indicate as anomalous. Every one who has had much to do with scientific illustrations will understand how the thing was done. The engraver removed what he regarded as a fault in drawing—result, a valueless picture. The picture sent by Mr. Ward shows what Ball really saw,—or rather what, by a curious optical delusion, he seemed to see. We must thank Captain Noble for restoring to Cassini the credit (whatever it may be worth) which is due to him in this matter.]

HIGH TIDES.

[593]—In your issue of Sept. 29 you kindly inserted my predictions of the high tides of Sept. 26–30. It may interest some of your readers to know how far these predictions were fulfilled. I take the computations as they stand in your paper, with 8 ft. 6 in. deducted, as there directed, and the observations are those made at the self-registering gauge at George's Pier, Liverpool, from the level of the Old Dock sill. It will be noticed how accurately the "diurnal inequality" is accounted for:—

Date. 1882	Calculation. ft.	in.	Observation. ft.	in.	Error. in.	Bar, Wind, direction and force.	
Sept. 26...	18	9	18	6	6	29.6 S.E.	fresh
	20	7	20	6	1	29.4 S.S.W.	slight
„ 27...	20	0	20	0	0	27.4 S.	calm
	21	8	22	3	7	29.5 W.S.W.	very strong
„ 28...	20	8	20	7	1	29.6 W.N.W.	fresh
	—	—	—	—	—	—	—
„ 29...	21	10	22	0	2	29.6 W.S.W.	slight
	20	6	20	8	2	29.6 W.S.W.	fresh
„ 30...	20	11	21	6	7	29.6 W.S.W.	very strong

JAMES PEARSON, M.A., F.R.A.S.

LONG TRICYCLE RIDE.

[594]—Mr. G. S. Newth, of New College, Hampstead, yesterday rode to Bedford, 50¼ miles, on his "Otto," in the face of wind and rain, leaving London at 5.30 a.m., reaching Bedford 10.45.

Starting on the return journey at 1.30, London was reached by six o'clock. Allowing 15 minutes for refreshment, the 50 miles were ridden in 4 hours 15 minutes, and the entire journey of 100 miles in 9¼ hours, without any previous training, and on wet, soft roads. J. F. P.

Sept. 22.

WOLLASTON AND FAIRY-RINGS.

[595]—In justice to the memory of one who is no longer with us, we beg, with your permission, to point out that the fungus theory of the origin of fairy-rings, advocated by certain of your correspondents, was propounded, so long ago as the beginning of the century, by the celebrated Dr. Thomas Hyde Wollaston. His paper on the subject is to be found in the *Philosophical Transactions*.

Alfred W. Soward,
I. Probert.

SPIRITUALISM.

[596]—About eighteen months ago I attended a lecture of Mr. Stuart Cumberland on spiritualism, his object being to expose the spiritualists. Considerable controversy took place between Mr. Cumberland and his opponents, but the latter were entirely defeated, inasmuch as they were afraid to come on his platform, fearful lest he should expose them. About ten months ago Mr. Carl Von Buch, of Lancaster Gate, and a friend, were fortunate enough to relate in the *Times* the capture made by them of a celebrated medium in the act of personating a spirit. This occurred in the rooms of the British National Association of Spiritualists, 38, Great Russell-street, now reconstituted under another name, where similar seances have been since held.

Recently, another well-known medium of the Association, a Miss Wood, was caught in the same manner by a spiritualist, who, having had his suspicions aroused, seized the "Ghost," and found it to be identical with the medium herself, while the chair was, of course, empty. We shall again, probably, have another explanation from the Central Association of Spiritualists, of the unfortunate medium made by their spirits "to act part wholly irrespective of their own volition," and other similar jargon, to prevent, if possible, the defection of their wavering adherents and the loss of substantial contributions to the good cause. As long as the world exists there will be dupes, and, therefore, knaves to dupe them, for the demand creates supply, and the supernatural has always exercised a fascination over many. The truths, if there be any, of spiritualism may be a legitimate field for inquiry, but a few good *exposés* of paid mediums will probably deter many from becoming victims to a fraud the worse in that it trades on the most sacred of human feelings, viz., the sanctity of the dead. E. P. W.

DR. HUNTER'S EXPERIMENTS.

[597]—Allow me to remark that Professor Owen's statement regarding Hunter's discoveries (Knowledge, July 28) does not agree with Sir William Fergusson's, mentioned in one of the articles on Vivisection in the *Nineteenth Century* (February, 1882). Sir William Fergusson says:—"So far as I have been able to make out—and I have inquired into the subject—Hunter's first experiment, if it may so be called, was on the human subject; and it was long after he had repeated his operation on the human subject, and others had repeated it, that the fashion of tying arteries on the lower animals originated and was developed."

San Remo. Mathilde van Eys.

THE FIFTEEN PUZZLE.

[598]—The "box-turning" solution of this puzzle from the lost position can be accomplished in 39 moves by moving the blocks in the following order:—14, 15; 10, 6; 7; 11, 15; 10, 13; 9, 5, 1; 2, 3, 4; 8, 12; 15; 10; 13, 9; 5, 1, 2; 3, 4, 8; 12, 15, 14; 13, 9, 5; 1, 2, 3; 4, 8, 12; turning the box whenever you please. A. B.

FLINT JACK.

[599]—Seeing that a reader of Knowledge (page 268) wishes to know where and how the wanderings of this celebrated man were ended, I wrote to the head-master of a large public school where I had heard "Flint Jack" mentioned in a lecture, and he kindly informed me that he had seen a collection of his manufactures and a photograph of him in the Blackmore Museum at Salisbury, and was told that he was there taken up as a vagabond and died in gaol, either at Salisbury or at Exeter. E. T. C. W.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* Knowledge, *the increasing circulation of which compels us to go to press early in the week.*

Hints to Correspondents.—*1. No questions asking for scientific information can be answered through the post. 2. Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries. 3. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 4. Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

L. R. S. Proportional to x^3 and proportional to $(2x)^3$, are exactly the same thing.—W. H. E. Ruth. Thanks, but for the present cannot find space for your letter. Much of what you say has been said by others (whose letters have reached us before yours).—Haih. Your advice is excellent. I have ordered a new and very large waste paper basket, so that, as you pleasantly put it, "a place of honourable and luxuriant rest may be provided for the products of captiousness and hypercriticism."—A. B. I fear that no more space can be given to that Algebraical problem. It may be worth noting, however, that the two equations, $x^2+my=a^2$ and $y^2+nx=b^2$ represent two parabolas, having their axes coincident with the axes of y and x respectively. The former cuts the axis of x in two points, a, 0, and $-a$, 0, and the axis of y in the point 0, a^2+m; the other cuts the axis of y in the points 0, b, and 0, $-b$, and the axis of x in the point b^2+m, 0. These parabolas may intersect in two points or in four, according to the values of a, b, m, and n.—If A. H. will send me one of the photographs referred to I may be able to give him the information he seeks. If the picture is on glass it may have been whitened with bichloride of mercury (A. Brothers).—C. Y. W. [Letter 584, page 314] will find a full description of the Glycerine Barometer in the *Times* of 25th October, 1880 (Vega).—D. Illingworth. The *rationale* of your formula is bound to come out if we test it. Thus, let n be the number of the month, a the man's age last birthday. The first process of your formula gives us $2n+5$. You multiply by 50, subtract 365, and then add 115. Clearly this gives $50(2n+5)+a-250$, or $100n+a$. In other words, the resulting number has his age in the last two figures, and the number of his month in the preceding digits or digit.—Taranaki. I have not heard of the paper you mention on the boomerang. I should like to, the subject being one of great interest to me. It seems to me to illustrate well the flight of birds.—T. wishes to know how the colour can be restored to the metallic scarlet of old plates.—F. R. M. would like to have a statement of the circumference, long and short diameters of (1) the Dolichocephalic, (2) the Brachycephalic, and (3) the average modern English skull.—J. B. Thanks. Good for our Gossip.—T. A. The explanation of the tides and of twilight is doubtless often incorrect in our school-books.—Surgeon. Mr. Brudenell Carter is doubtless right about the rays surrounding stars. They are, of course, subjective phenomena. But he was quite mistaken about the Solar Corona. That theory was entertained by many who had never seen the Corona, not by any who had. If there had been any occasion to disprove it, the photographs would have done that for us. But the coronal rays are not at all like those seen around a luminous object.—H. A. would like to know if there is any evidence to show that dogs by accidentally biting themselves, as when flea-hunting, may self-inoculate themselves with hydrophobia.—Eliz. Brown. There is no reason for associating the colours of self-luminous paints with the phenomena of metachromatism.—W. Parker. Your letter reached us too late for useful reply.—H. J. White. Prof. Tyndall's Address (Belfast) is published as part of the later editions of his "Fragments of Science" (Longmans). He certainly never made an apology for that able address. It assuredly needed none, even for those who differed from him. As for the little sum you set, I must really decline to work it. We must draw the line somewhere.—G. Griffiths. There is no way of telling the odds against one horse from the known odds against another.—H. B. Richardson. Do not know the publishers of Mr. Birley's "Zetetic."—W. H. Banwell. Like you, I did not quite see what, in Mr. Arnold's article, drew down my friend's attack. If I were asked which I would rather give up, my literary or my scientific studies, I should unhesitatingly say the latter. Fortunately there is no occasion to give up either. Of course I am speaking only of the personal pleasure either form of study affords, not of their usefulness. But I have the greatest possible contempt for the class of classical studies to which F.R.A.S. referred.—Bevan Lingwood wants to know of an English translation of Demosthenes' "Philippics."—Opifer, J. E. S. They were electric clouds.—Wood. The cause of light is not known. Science can only discuss the nature of light; she can deal with the How, not with the Why.—F. C. I am very sorry, but it would really be impossible to give

any answer which would be of use to you without departing from our necessary rules.—Young Chemist. We cannot say which is the best book on Qualitative Chemical Analysis.—J. M. You ask for an impossibility. If one outline of a garden path is elliptical and the path is of uniform width, the other outline is not elliptical.—Hallyards. The strength of the Rainband only corresponds in a general way with the rainfall.—F. W. R. See numbers 48 and 49 for account of Rainband observations.—J. Munro. Quite impossible to appoint meetings to discuss manuscripts.—F. Gardner. Papers about Level Berths received. We do our level best, but our subjects get ahead of us sometimes (as the queen says).—A. G. Haynes. We make the assumptions you refer to only in illustrating the differential calculus, not to prove anything. — Malcolm Douglas. You are quite right. The u in the numerator of right right hand fraction in lowest formula on page 172, first col., should be changed to $1+s$.—J. Fraser. I believe there is no known rule for determining the slip in the case of screw-propellers.—Newton Crossland. The reasoning you have used has been refuted. Your mistakes are familiar ones. I do not think your views have been refuted, in the sense in which you probably use the words. When my friend Mr. Dunkin told you he was unable to refute your views, he no doubt meant that he could not spare time to explain to you their incorrectness. Paradoxers labour under the erroneous idea that every holder of other views is bound to correct their mistakes.—John Greenfield. The earth's tilt is not caused by precession. I was right in saying that the cause of it is not known.— * * * recommends hot Scotch with a slice of lemon, to Mephisto, in preference to brandy. Does he recommend Three Star Whiskey? I fancy I recognise an old acquaintance in Three Stars.—J. F. B. Yes, p. 258, col. 2, eight lines from bottom, read "moon's" for "earth's."—B. Sanders. Noticed the misprint Truro for Tresco, but as no one would be likely to imagine a lifeboat used at an inland place, it did not seem worth while to correct. — F. Mackeith. Many thanks for notices of the American meeting. Will probably use some after due digestion.—Ignoramus. I should say the less a lad of sixteen or seventeen smoked the better. I dare say a half-bowl of mild tobacco per day would do no harm, but I am sure it would do no good. Then, would he stop there?—A Highlander. Perhaps some one who has had experience in the use of the Rainband spectroscope will give us a concise account of their experience.—Upsala. Now others very much like those papers. I am one of those who do. The earth's orbit is an ellipse; but on the scale of that picture you would not be able to tell it from a circle.—Shorthand Writer has taken no strong drinks for eight years, nor has he felt the need of them. He therefore firmly believes that "no man needs artificial stimulant—and strong drinks are artificial." But is not our life artificial most of the time?—H. Percival. A bladder does not weigh the same when empty and when distended with air; for, if distended with air, the air is at greater pressure, and therefore of greater density than the surrounding air. But if simply full of air, it of course weighs no more when weighed in air. Equally, an empty bladder and one full of water are of equal weight if weighed in water. But a bladder full of air weighs more than an empty one by just the weight of the air, when the balance is in a vacuum.—A. G. B. Kennett. What you saw was a solar halo. The ice-particles in the air at about 22° from the sun refracted the rays to the eye, each colour at its proper distance from the sun.—J. A. Robson wants a book on isometrical drawing and projection other than Sopwith's.—C. Hankinson. Wants a cheap book on the blowpipe.—T. Such questions more suitable for an educational journal.—T. M. Not quite suitable.—Æsthete. (1) A nautical mile is the sixtieth part of a degree. There are rather more than 69 land miles in a degree. (2) I do not know how to keep sunflowers fresh as long as possible. By the way, how do you Æsthetes keep sunflowers free from earwigs?—W. H. Lane. I believe no one has yet measured accurately the distance at which a cannon-ball has passed a man's head without killing him. The observation would be rather a delicate one, I should imagine. Very likely six inches is the limit. I should be content with as many yards.—J. Spiller. We have scarcely so much available space as we had, but will find room if possible.—Grateful is much pleased with Natator's instructions; he has "learned more," he says, "from his simple rules than from all the books he has seen." This will gratify Natator much.—J. H. Ward says his binder charged 3s. 6d. for binding volume I. "Moral": Send next volume to publishers for "binding." He advises Constant Reader to advertise his address as he did. He also tells J. Dimmock that Professor Virchow's address, "Freedom of Science in the Modern State," is published by Murray at 2s.—Excelsior. Thanks. Soon.—E. T. C. W. My lectures will one day be published. At present they are changing all the time.—M. E. L. The editor of Knowledge is rather disposed (it may be the result of some personal prejudice) to recommend for the purpose you mention, Mr. Proctor's work, now in the press, "The Stars in their Seasons," republished from Knowledge. For a first very simple guide, Mr. Proctor prepared "Half-hours with the Stars"; for fuller information the maps which have appeared here; for a knowledge of the quaint lore of the constellations, and other such matters, the "Easy Star Lessons." Each work, however, is complete in itself. I believe the publishers propose to reprint Five of Clubs' Whist disquisitions, in the form of an easy Guide to Whist, soon after they are completed.—Chas. Witham. I thank you, and the other subscribers in whose name you write, very heartily.—C. S. You are quite right; the previous predominance of heads in no way renders the occurrence of a run of tails likely. There is no tendency to exact equalisation, only to equality of proportion. Thus, if there are to be a million tossings, it is very unlikely, antecedently, that there will be exactly 500,000 heads and 500,000 tails; but it is also very unlikely that the ratio of heads to tails will differ from unity by more than one-thousandth part. In other words, it is most probable that both heads and tails will lie in number between 499,750 and 500,250, but very unlikely that they will both be 500,000. Yet note that 500,000 is the most probable of all results—the most probable, yet very unlikely as compared with all other results taken together.—Leonard D. You are doubtless right, but accuracy is secured by the power of correction. You may notice, for instance, that the Editor has recently not only corrected in these columns a mistake of his own, but published his correction elsewhere. This is, of course, only right. There is not a particle of merit in doing what it would be very wrong to leave undone. But if we all agree to point out our errors or to accept readily the corrections of others when we recognise their correctness, we cannot go very far wrong. Why did not you send a letter with your corrections, for publication? You may be sure it would have found a place.—Nausea. I doubt if there is even any alleviation for sea-sickness. You may prolong the trouble by slightly diminishing it, but the totality of misery is much the same. Yet remedy may be found in attention to the health before starting. If you take plenty of exercise for a fortnight, eat no pastry, little butter or cheese, and even reduce your customary allowance of milk, you will, if your constitution is like mine, suffer much less than you otherwise would. I have crossed the Atlantic in misery for the first five days on three occasions, and on three others without a qualm from shore to shore, the weather being rough all six times.—Solanum. It is admitted toads are not venomous.—J. Stevens. Thanks for Flint Jack extract.—W. B. Wicken. It is chiefly because the temperance cause is injured by attacks on the moderate, that these are to be deprecated. If a Blue-Ribbonist asks me whether I sympathise with his cause, my answer is that I do most heartily; but if he asks me to denounce moderate drinking, and to assert, contrary to all experience, that most moderate drinkers end by becoming inebriates, I am obliged in common honesty to tell him, "that's a bay horse of another colour" (American version of our familar saying).—Subscriber. You want to know too much at once. But as you hail from Victoria, I answer. 1. The moon actually does rotate on its axis once in each circuit around the earth. (2) A diagram showing the moon's path for a year should be about three yards across. We have not space for that. (3) The moons of Jupiter move rather differently from our moon, their motions being more rapid, relatively, in their own orbits, and Jupiter's less rapid in his. (4) Certainly; many comets travel from star to star. (5) Given a passage through the centre of the earth (I am sure I have no objection) and a body of the same density to fall through, how far beyond the centre would it go, and how long would it oscillate? Well, that would depend on the resistance of the gases in the passage. If there were none, the body would oscillate through a whole diameter each way for ever. —Scout. It strikes me Mr. Foster was joking when he said, in his article on Nature Myths, that Tom the Piper's Son was the Thammuz of the solar myth. Perhaps Tom was. Perhaps, also, the Swan into which the Ugly Duckling turned was afterwards Leda's Swan, and later, in partnership with Mr. Edgar, took a shop in Piccadilly for the sale of articles of haberdashery to the Ledas (I would say leaders) of fashion.—F. W. Millett. It would be hopeless to attempt to determine the true position of the auroral streamers from such observations.—R. Q. P. Yes, Carlyle's statement is quite correct. Any motion brought about by internal reactions alters the centre of gravity of the system.—J. A. Westwood Oliver. I think Boss and Smyth about right as to the destruction of the comet, but our earth is all right, I should imagine.—Alb. Barrett. I believe Aristotle was the first botanist whose works are extant. Only one would hardly call him a botanist, who studied so many subjects.—W. Probyn Nevins. Yes, it is really too bad of him to frighten all the other old women about the mischief the comet is to do the earth.—H'sett. Do not know of any data by which time taken to make "pot-holes" can be determined.—J. Mackenzie wants to know the names of the authors of "The Key

of the Universe," and "The Theory of Progression."—F. A. Bellamy. Mr. Collyns's book is quite paradoxical. He has mistaken the proof that the apparent brightness of the sun is the same from whatever distance it is seen, for a proof that the same amount of light is received from it.—T. Winder. Thanks; it shall appear.—E. D. G. Yes, Routledge's "Discoveries and Inventions of the Nineteenth Century" is good; but surely you do not call it "a complete history of the Advance of Science" during the time? That was what I was asked for.—F. Stanley. Thanks. You will see that your wishes are already attended to.—Geo. Kamensky. Thanks; but no space at present.—C. W. Y. All right; Philology soon.—M. J. Harding. Will try to do so. But the publishers wish to bring out the maps in book form, and may not approve of a second printing of those maps. You doubtless notice the difference of scale.—R. Forrow. No mistake of that kind has been made. The true course of the comet does not intersect the sun.—T. E. Bonser. Truly, your suggestion seems an excellent one. It shall be followed.—Deo Fido. Yes, the new use of the "stethoscope" to foretell rain is striking.—N. W. S. You should divide by the *cube*, not by the *square* of B L. "That's how the error has arisen."

ELECTRICAL.

A. B. (1) Thanks. With an already acquired knowledge of electricity your age (20) would doubtless prove a very convenient one for commencing practical studies preparatory to becoming an electrical engineer. (2) I do not think you will do far wrong in joining the school. Go and see for yourself. I imagine electrical engineers are far too busy to find time for instructing pupils. (3) Electrician and electrical engineer are, to all intents and purposes, synonymous, the latter having, perhaps, a slightly more practical ring about it. There are times when one name has a preference over the other—for instance, we should speak of an amateur electrician, but scarcely of an amateur electrical engineer.—Puzzled. The explanation of your difficulty will probably be that a Bunsen battery running down in four hours or so, the accumulator discharged itself during the night through the Bunsen, leaving a deposit of sulphate of lead on one of the plates. This is insoluble and non-conducting; accordingly, when you attempted to pass a charging current, it did not for a time get through; eventually, you say, it did get through, but left no stored energy. This was doubtless owing to the blotting paper which separated the much-too-closely-packed-plates, rotting through and falling to the bottom, *lead-trees* then forming across the space separating the plates. Use felt or asbestos next time. A medical coil revolving at a high speed would hardly suit your purpose, as it would give too much electro-motive force, while you would be deficient in current strength or quantity.—W. S. If space permits, your request shall be complied with, but supply and demand are not yet equal.—A. E. Neal. The Post-office, I think, sometimes sell single needle telegraph instruments at £3. 15s. each. If you cannot get supplied there, try the Silvertown Company, or Clark, Muirhead, & Co., Westminster.—C. J. Eve. 1, 2, 3, and 4, will be answered shortly in an article. (5) The Siemens' Armature is the simplest and best for your purpose. We have yet to learn which is the most efficient, after taking all things into consideration. (6) Yes. (7) Your wish shall soon be gratified, want of space is the only difficulty.

Letters Received.—Dazed.—J. Bemrose.—E. B. W.—T. E. Bonser.—Arturus.—Romolo.—Maui.—G. A. S.—W. F.—G. J. Over.—F. C. Brown-Webber.—Daleth.—W. Hainsby.—W. Ackroid.—T. Walker.—W. C. Masters.—James Cram.—Gradatim.—Another Perplexed Student.—E. M. King.—Samson.—J. Greenfield.—Newton Crosland.—S. Barker.—Lara.—W. Bolden.—J. Davidson.—More Light.—I. J. Rubie.—An Oxford Student.—C. I. Brown.—H. W. H.—J. E. Howe.—W. S.—W. M. Beaumont.

Our Whist Column.

By "Five of Clubs."

We continue our brief summary of the chief rules for play—the axioms of the science, as it were—not to know which argues Whist unknown.

Play Third Hand.

Play your best if above and not in sequence with your partner's lead, and above second hand; but play lowest of head sequence, or of head cards otherwise equal in value (as Nine from Nine, Knave, King, if Ten and Queen have been played). But holding Ace, Queen, play the Queen, unless a single trick saves game.

You can safely finesse in trumps when strong in them, sometimes even against two cards. Never play a *needlessly* high card third in hand. If you can win the trick or force out the King card with a Ten or a Nine, it is a Whist offence of the first magnitude to play the Knave.

Play Fourth Hand.

Win the trick, if against you, as cheaply as you can. It is very seldom good policy to pass the trick for the chance of making two, unless the chance is almost a certainty. But if at the score two tricks are wanted to save the game, then, of course, you should try for the two tricks at the risk of losing even the one in your power. Only win your partner's trick when you are sure, or almost sure, of gaining at least two tricks by getting the lead into your hands. With the King card of your partner's suit, singly guarded, and only losing cards besides, take the trick from your partner and lead him the little one, unless one trick more will save the game, in which case, of course, your King card in your partner's suit will make it. Otherwise, it can make but that trick, and you cannot lead your partner his suit.

Leading Trumps.

Lead trumps when you see a good chance of getting out trumps and bringing in, either by long trump or re-entering card, your own or your partner's suit. With an established suit, every card left in the suit is a means, if wanted for the purpose, of drawing a trump from the adversaries. In estimating, then, your chances, count these winning cards as part of your strength against the enemy's trumps. Weak players seem unable to understand this. "Why should I lead a card for the enemy to trump?" they ask. The answer is, that a long trump against you will make, do what you will; if it takes one of your long suit, and leaves you the rest as winning cards, with power to bring them in, it does you the least harm possible. If, instead, you carefully refrain from forcing it out, and play (as weaklings always *will* do) your head-cards in the opponents' suits,—that long trump is used not only to win its single trick, but to bring in the enemy's long cards. You *do not even save a single trick by failing to force, and you may lose two or three you might have made.*

Leading trumps from a weak suit is only excusable when, either you have commanding strength in all the plain suits, or the enemy have established a cross-ruff, or nothing but a strong trump hand of your partner's can save the game.

Rules Constituting the Language of the Game.

Return the highest of two left after first round; the lowest of three or more. Neglect of this rule is a very serious mistake: in trumps it often proves disastrous. With very strong trumps and a good suit, signal at the first opportunity, by playing or discarding an unnecessarily high card before a low one in the same suit. Remember, however, that strength which will justify a trump lead will not justify signalling. Leading trumps means that the trump lead is likely to suit your hand; signalling means that it is *certain* to do so. When your partner has signalled, lead your best trump at the first opportunity, unless you have four or more, when lead the smallest; but with four, three honours, or Queen, Knave, Ten, another, lead the best. Meantime, note that if he is a good player he will look out for the "echo to the signal"—so, if you have four trumps, or more, you should signal (in any suit,—including trumps). So also, if your partner leads trumps, and you hold four or more, no matter how small, you should signal in trumps, or at the first chance. Lastly, in leading a small card from a five-card suit, play the lowest but one, and follow with the lowest. This signal, called the *penultimate*, means that you have five in the suit, unless the circumstances are such that you might have led the highest of a short suit; in which case it is best to lead the lowest, for the consequences of a mistake as to a suit being strong or weak are likely to be much more serious than those arising from doubts as to your holding four or five.

TO CORRESPONDENTS.

P. A. R.—You held the second best trump, the place of the best being unknown, your long suit was established, and you held a couple of cards in your partner's suit. You ask us what you should have done. Can there be a shadow of a doubt? Your proper course should have been as clear as day to you. What you did was, you say, to play your trump, finding the best with your partner, who could not lead you your suit, so the adversaries made their long cards. Pardon me for saying that you were rightly served; but *it was hard on your partner.* You should have led the best card of your established suit. If the best trump was with an adversary, you would thus have forced it out, and your long trumps would then have brought in your suit, after playing out which you would have led your partner's. As the cards lay you would, of course, have done better still. It is utterly absurd to try to save every card of your long suit in such a case.

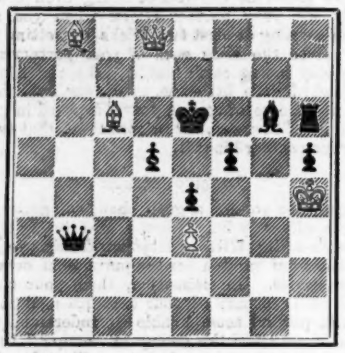
Our Chess Column.

By Mephisto.

PROBLEM No. 58.

By Leonard P. Rees.

BLACK.



WHITE.

White to play and mate in two moves.

An interesting specimen of a Cunningham Gambit recently played at Mephisto's rooms :—

White. Mephisto.	Black. Amateur.	White. Mephisto.	Black. Amateur.
1. P to K4	P to K4	11. Kt takes B	B takes R (*g*)
2. P to KB4	P takes P	12. Q to Kt4 (*h*)	Castles (*i*)
3. Kt to KB3	B to K2 (*a*)	13. Kt(R4) to B5	P to KKt3
4. B to B4	B to R5 (ch)	14. Kt(B5) to K7 (ch)	K to R sq (*j*)
5. P to Kt3 (*b*)	P takes P	15. P to QKt3	Kt to Q2
6. Castles (*c*)	P takes P (ch)	16. B to Kt2 (ch)	P to B3
7. K to R sq	P to Q4 (*d*)	17. R takes B	P to B3
8. B takes P	Kt to KB3	18. Q tks Kt (*k*)	Q takes Q
9. Kt to QB3 (*e*)	Kt takes B (*f*)	19. R tks P (*l*)	P to KR4
10. Kt tks Kt	QB to KR6	20. R to B7 mate.	

NOTES.

(*a*) Although this defence is considered inferior to either P to KKt4 or P to Q4, but it has the merit of tempting an opponent into the Cunningham Gambit, which is considered unsound, and it likewise avoids the stronger attack of the Allgaer Gambit.

(*b*) This move constitutes the Cunningham Gambit, which sometimes leads to some very lively play, although the books pronounce it unsound. "5. K to B sq is given as better to be followed by P to Q4, after which White obtains a good position, and will regain the Gambit Pawn." We do not agree with this. In practice we have often found it difficult to win against that defence. We also introduce the following new move to the notice of our readers, as it gives a better defence, *i.e.*, if instead of P to Kt3

5. $\frac{\text{K to B sq}}{\text{B to B3}}$ 6. $\frac{\text{P to K5}}{\text{B to K2}}$ 7. $\frac{\text{P to Q4}}{\text{P to Q4}}$ 8. $\frac{\text{B to K2}}{}$

Here the books give as a continuation for Black, P to KKt4; this allows White to attack by P to KR4, and he obtains a good game. Instead of this move it would be better to abandon the Pawn that cannot well be defended, and proceed with 8. P to QB4, to be followed (probably) by Kt to QB3, and we think that Black's defence is superior to White's attack.

(*c*) White hopes to obtain compensation for his Pawn by an attack founded on the fact of his Rook having the command of the KB file in conjunction with the threat of B takes BP (ch) and Kt takes B discovering check, &c.

(*d*) Considered best. It allows Black to play 8. Kt to KB3, threatening to capture the Bishop, and making the position of the Rook on KB sq somewhat ineffective.

(*e*) Mephisto, finding his opponent "well up" in this defence, has recourse to innovation. The usual move of B takes P (ch) does not yield the first player any advantage.

(*f*) White threatens $\frac{\text{Kt takes B}}{\text{Kt takes B}}$ $\frac{\text{Kt takes Kt}}{\text{Q takes Kt}}$ Kt takes QBP.

(*g*) 11. Q takes Kt (R5) would have given Black a better game.

(*h*) A bold sortie, giving White a strong counter attack. If Q takes B, Black would reply with P to QB3.

(*i*) P to KKt3 would not have been much better, for White can shut in the Black Bishop by 13. P to Q3, threatening B to Kt5 or B4, followed by R takes B with a winning game.

(*j*) K to Kt2 would have enabled White to play Q to R4, threatening the dangerous checks on R6 and B6.

(*k*) This move at once forces the game.

(*l*) Threatening mate by discovered check with the Bishop next move.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Alfred B. Palmer.—Problem received with thanks.

Teddington.—In Problem 56 the two Pawns on White QKt6 and Black QKt2 are necessary to prevent a second mate after 1. B to Kt6 ; but the problem is altogether wrong.

F. Dee.—Thanks for communication. Solutions correct.

Leonard P. Rees.—Problem already on hand. End position has given universal pleasure. Your Problem No. 57 we are assured is not a copy from that published in 1878 in the *Nottingham Express* ; nor can we think that Mr. Spray has copied his position from a precisely similar problem, which appears in "Alexandres Beauties of Chess," by Paul Loguin, the position of which is White King on QKt6, Bishop on KKt3, and Rook on Q sq. Black King on QB sq. The idea being simple, it may occur to several more composers.

W. M. Foxcroft.—Solutions correct.

S. Bassan Lello.—Solutions correct. For No. 55, see last week's issue, where all solutions are given.

John Simpson.—The problem referred to is a four-mover by a German composer (Eichhardt), where a similar mate with two Knights occurs; perhaps some of our readers will recollect the position. We hope soon to publish some select reprints.

J. B. B.—Solutions (very) correct.

Correct solutions received of Problems No. 56 and 57 by J. P., G. W., C. L. B., E. A. F., F. S. L. No. 57, by Billy Batton, Bernard Wilmot, F. C. Hyland.

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